

**REMARKS**

Upon entry of the foregoing amendment, claims 1-15, 17-33, and 35-36 are currently pending in the case with claims 16 and 34 canceled without disclaimer of, or prejudice to the matter contained therein. Claims 1-36 stand rejected as being indefinite under 35 U.S.C. § 112, second paragraph. Claims 1-36 also stand rejected as being anticipated under 35 U.S.C. § 102 (b) by U.S. Patent No. 5,121,337 to Brown, and as being anticipated under 35 U.S.C. § 102 (e) by U.S. Patent No. 6,895,411 to Keller.

Applicant has amended the claims to address the indefinite issues identified by the Examiner. Support for the amendment of claims 1-5 and 19-23 is found in the specification at pages 4-5 describing the sequential use of residuals to identify independent variables in order of their importance, and to define functions that define the contribution of each independent variable to the data set, such that at each stage of the analysis, the model comprises contributions from an increasing number of independent variables. Also, claims 6, 18, 24 and 36 are amended to clarify that the step of identifying functions to describe the contribution of the most important independent variable to the dependent variable comprises comparing the numerical values for the dependent variable versus a plurality of transformations of the first most important independent variable, wherein each transformation uses a distinct mathematical function selected from a set of families of functions, to identify a function that provides the best fit of the first independent variable to the data. Similar amendments are made to claims 6, 18, 24, and 36 to clarify that the step of identifying functions to describe the contribution of the other most independent variables to residual values for the dependent variable comprises comparing the numerical values for the residuals versus a plurality of transformations of each of the next most important independent variables, wherein each transformation uses a distinct mathematical function selected from a set of families of functions, to identify a function that provides the best fit of the next independent variable to the data. Support for these amendments is found in the specification at pages 4-9 describing the sequential use of residuals to define functions to describe the contribution of each independent variable to the dependent variable, and at pages 9-10 and Table 1, describing sets of families of functions. Other amendments made to clarify certain steps in the claims are supported by the specification at pages 4-13 and the claims as originally filed.

Also, Applicant has amended the specification to correct typographical errors. Accordingly, no new matter is added by the amendment of the specification or claims.

***The Rejection of Claims Under 35 U.S.C. § 112, Second Paragraph Is Traversed Or Rendered Moot)***

The Examiner rejected claims 1-36 as indefinite under 35 U.S.C. § 112, second paragraph.

Claims 1 and 19

The Examiner rejected claims 1 and 19, stating

[The claims recite] “determining the relative contribution of the at least one independent variable to the dependent variable, and defining separate functions that each describe the contribution of a single independent variable to the dependent variable”. [Also, the claims] recite “at least one independent variable”. If there is only one independent variable, then the relative contributions step has no meaning, since there are no other variables for comparison.

With respect to “defining separate functions that each describe the contribution of a single independent variable to the dependent variable”, the claim does not identify the “single independent variable”. If there is only one independent variable, it is clear what is meant. However, if there are more than one independent variable, the selected variable is not identified. The claim[s] [do] not recite how to define the functions.

Office Action at pages 2 and 4. The claims have been amended to recite a plurality of independent variables. Also, claims 1 and 19 have been amended to clarify that the functions used to describe the contribution of an independent variable to the dependent variable are determined sequentially, using residuals of the dependent variable to define the portion of the dependent variable for which a contributing independent variable has not been defined, such that at each stage of the analysis, the model comprises contributions from an increasing number of independent variables.

Claims 6 and 24

The Examiner rejected claims 6 and 24, stating that:

[The claims recite] “identifying the independent variable that makes the largest contribution to the dependent variable as the first most important dependent variable”. If there is only one independent variable, then the largest

contribution step has no meaning, since there are no other variables for comparison. Thus some of the remaining steps will not make sense. [Also, the claims] recite, "plotting the dependent variable versus transformations of the first most important independent variable to determine a function that provides a model having the best fit to the data." There are no steps reciting what the transformations are. Thus, it is not understood how the transformations result in a model having the best fit to the data.

Office Action at pages 3-5. The claims have been amended to recite a plurality of independent variables. Also, the nature of the transformations is defined as using a distinct mathematical function selected from a set of families of functions, to determine which function provides a model having the best fit for the selected independent variable (i.e., the first most important independent variable or the sequentially next most important independent variables) to the data. Example sets of families of functions that may be used are shown in Table 1.

#### Claims 18 and 36

The Examiner rejected claims 6 and 24, stating that:

[The claims] recite, "determining which independent variable comprises the most significant contribution to the dependent variable". If there is only one independent variable, then the most significant contribution step has no meaning, since there are no other variables for comparison. Thus some of the remaining steps will not make sense.

[Also, the claims] recite, "plotting the values of the dependent variables against an initial set of selected functions". There are no steps reciting how these functions are selected. The rationale for selecting the functions must be consistent with the analytical approach. For example, if the chosen function is  $F_{\text{initial}} = 0$  for all values of  $x_2$ , this step is not useful. Plotting each variable against some random or arbitrarily selected function may result in a different result after determination of the residuals and the associated analysis.

Office Action at pages 3-5. The claims have been amended to recite a plurality of independent variables. Also, the nature of the transformations is defined as using a distinct mathematical function selected from a set of families of functions, to determine which function provides a model having the best fit for the selected independent variable to the data. Example functions that may be used as the set of families of functions are shown in Table 1 of the specification. The sets of functions may comprise families of functions such multi-term polynomial functions, log functions, power functions, sine functions, log functions, exponential

functions, and logistic curve functions. The method does not require that all of the functions must be consistent with a predetermined analytical approach. The Examiner has provided a scenario, stating that where  $F_{\text{initial}} = 0$  for all values of  $x_2$ , the step would not be useful. In fact, this would be a function that would not provide a reasonable fit of  $x_2$  to the curve and so, would not be chosen as a function explaining the fit of  $x_2$  to the  $y$  variable. Still, because of the large number of individual functions provided by each family of functions, and the systematic nature of the approach, a function that best describes the contribution of the particular independent variable to the dependent variable will be selected from the set of families of functions. Also, as described in the specification at page 11, lines 21-28, the set of families of functions may be expanded as needed, should additional analyses be required to fit an independent variable to the residuals.

For at least the above reasons, the Applicant respectfully asserts that as amended, the claims are not indefinite under 35 U.S.C. § 112, second paragraph, and requests that the rejection be withdrawn.

***The Rejection of Claims Under 35 U.S.C. § 102(b) Is Traversed Or Rendered Moot***

The Examiner rejected the claims as anticipated under 35 U.S.C. § 102(b) by U.S. Patent No. 5,121,337 to Brown. Thus, the Examiner stated:

From (C52, L15) to (C54, L65), Brown discloses a computer implemented method and system to find a mathematical equation that fits a number of variables having one independent variable and at least one independent variable. The use of residuals and the Student  $t$  distribution to place confidence limits around the coefficients to find the most significant coefficients is commonly known to one of ordinary skill in the arts of statistics and experimental design.

Office Action at page 6.

Applicant respectfully asserts that Brown does not describe, teach or suggest all of the elements of Applicant's method and computer readable medium. Applicant's method provides a stepwise analysis by which data is described mathematically using a plurality of independent variables, and sequentially fitting independent variables to the data until an equation that describes the data set is defined. Applicant's claimed method includes the steps of: identifying a first independent variable (e.g.,  $x_1$ ) and associated function ( $f$ ) that explains part of the data set;

determining the residual value for the data that does not include the contribution of the function of the first independent variable (e.g.,  $f(x_1)$ ); then identifying a second independent variable ( $x_2$ ) and its associated function ( $f(x_2)$ ); determining the residual value for the data that does not include the contributions of the first and second independent variables; and continuing to fit independent variables to the data until the contribution of all of the statistically relevant independent variables is mathematically described. Thus, Applicant describes and claims the use of residuals derived by subtracting the contributions for independent variables from the data set to define mathematical functions for additional independent variables that are then fitted to values for the dependent variable.

There is no description, teaching or suggestion in Brown of a method to find a mathematical equation that fits a data set having one dependent variable and a plurality of independent variables comprising determining the relative contribution of each independent variable to the dependent variable, and using residuals to define separate functions that each describe the contribution of each independent variable to the dependent variable. Nor is there any description, teaching or suggestion in Brown of the steps of: (a) identifying the most independent variable and identifying a single function from a plurality of functions to describe the contribution of the first (most important) independent variable to the dependent variable; (b) calculating the residuals for the dependent variable, where the residuals are the portion of the dependent variable that is not included in the function describing the contribution of the first independent variable; (c) identifying the next most important independent variable and identifying a function from a plurality of functions to describe the contribution of the next most important independent variable to the dependent variable; (d) calculating the residuals for the dependent variable, where the residuals are the portion of the dependent variable that are not included in the functions describing the contribution of the identified independent variables; and (e) repeating steps (c) and (d) until a plurality of functions describing the relationship of each of the independent variables to the dependent variable is attained.

In contrast Brown describes a method having the steps of: using matrix subtraction to remove data due to the measurement process, noise, or impurities; and fitting the independent variable (sample concentration) to the dependent variable (spectral absorbance) using a known function (e.g. Beer's law) using such techniques such as linear regression, principal components



analysis (PCA), or partial least squares (PLS). The matrix subtraction is performed by determining spectral data for  $n$  calibration samples at  $f$  discrete frequencies to produce a matrix  $X$  (of dimension  $f$  by  $n$ ) of calibration data. The first step in the method involves producing a correction matrix  $U_m$  of dimension  $f$  by  $m$  comprising  $m$  digitized correction spectra at the discrete frequencies  $f$ , the correction spectra simulating data arising from the measurement process itself. The other step involves orthogonalizing  $X$  with respect to  $U_m$  to produce a corrected spectra matrix  $X_c$  whose spectra are orthogonal to all the spectra in  $U_m$ . Due to this orthogonality, the spectra in matrix  $X_c$  are statistically independent of spectra arising from the measurement process itself. Brown at 3:13-25. In some cases, both baseline variations and ex-sample chemical compounds are modeled in the manner described to form two correction matrices  $U_p$  of dimension  $f$  by  $p$  and  $X_s$ , respectively.

The portion of Brown cited by the Examiner is part of the Appendix providing a background description of the technique of least squares regression and multiple linear regression. Least squares regression minimizes the sum of the squares of the residuals as a means to define the coefficients that are to be used to fit particular function to data. Multiple least squares regression is a technique that minimizes the residuals as a means to define the coefficients that are to be used to fit particular function to data. Least squares regression and multiple linear regression does not, however, utilize residuals to identify functions that can be used to describe the contribution of a particular independent variable to a data set.

For at least these reasons, Applicant asserts that nothing in Brown describes the use of residuals for the identification of functions that may be used to describe the contribution of a plurality of independent variables to a dependent variable, and thus, requests that the rejection of the claims as anticipated under 35 U.S.C. § 102(b) by Brown be withdrawn.

***The Rejection of Claims Under 35 U.S.C. § 102(e) Is Traversed Or Rendered Moot)***

The Examiner rejected the claims as anticipated under 35 U.S.C. § 102(e) by U.S. Patent No. 6,895,411 to Keller. Thus, the Examiner stated:

From (C12, L27) to (C13, L46), Keller discloses a prediction model utilizing linear regression techniques and residuals of the independent variable to obtain a best fit mathematical equation for one dependent variable and at least one independent variables. The use of residuals and the Student  $t$  distribution to place confidence limits around the coefficients to find the most significant coefficients

is commonly known to one of ordinary skill in the arts of statistics and experimental design.

Office Action at page 6.

Keller describes technique that uses partial stepwise polynomial regression as applied to distinct ranges for each independent variable to describe data comprising a plurality the independent variables ( $X_i$ ) and a single dependent variable. The ranges can be fixed or variable. See Keller at 5:15-12:14. The portion of Keller cited by the Examiner provides a comparison of the technique of partial stepwise polynomial regression and linear regression. It can be seen that the partial stepwise regression breaks the data into distinct ranges for the independent variable, as a way to better describe local relationships between each independent variable ( $X_i$ ) and the dependent variable. Still, there is absolutely no description in Keller of the use (a) identifying a first independent variable and identifying a single function from a plurality of functions to describe the contribution of the first variable to the dependent variable; (b) calculating the residuals for the dependent variable, where the residuals are the portion of the dependent variable that is not included in the function describing the contribution of the first independent variable; (c) identifying an additional independent variable and identifying a function from a plurality of functions to describe the contribution of the additional variable to the dependent variable; (d) calculating the residuals for the dependent variable, where the residuals are the portion of the dependent variable that are not included in the functions describing the contribution of the identified independent variables; and (e) repeating steps (c) and (d) until a plurality of functions describing the relationship of the each of the independent variables to the dependent variable is attained. Linear regression is a technique that minimizes the residuals as a means to define the coefficients for a linear equation so as to that are to be used to fit particular linear function to data. Linear regression does not, however, utilize residuals to identify functions that can be used to describe the contribution of a particular independent variable to a data set.

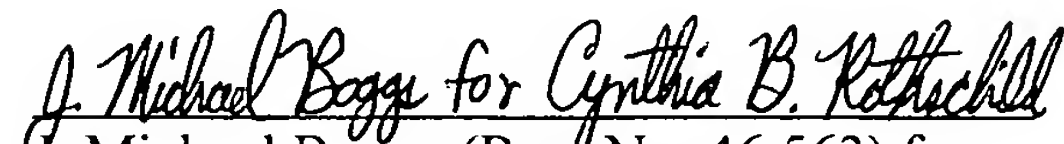
For at least these reasons, Applicant asserts that nothing in Keller describes the use of residuals for the identification of functions that may be used to describe the contribution of a plurality of independent variables to a dependent variable, and thus, requests that the rejection of the claims as anticipated under 35 U.S.C. § 102(b) by Keller be withdrawn.

**CONCLUSION**

In view of the foregoing amendment and remarks, each of the claims remaining in the application is in condition for immediate allowance. Accordingly, the Examiner is respectfully requested to reconsider and withdraw the outstanding rejections. The Examiner is respectfully invited to telephone the undersigned at (336) 747-7541 to discuss any questions relating to the application.

Respectfully submitted,

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